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Development of a Composite Questionnaire, the Valuation of Lost Productivity, to Value Productivity Losses: Application in Rheumatoid Arthritis

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ABSTRACT

Objective: Existing productivity questionnaires do not capture sufficient information to enable the proper valuation of an individual's productivity loss to a society. The purpose of this article is to develop a questionnaire that captures the time lost from work due to a health problem and job and workplace characteristics so that the value of productivity loss to society can be calculated. **Methods:** First, a questionnaire battery was developed by selecting items from existing productivity questionnaires. Next, items with similar content were identified and duplications were eliminated. Third, the draft questionnaire's feasibility was pretested in a focus group (n = 15). Finally, after appropriate refinements, its applicability was tested in 140 employed patients with rheumatoid arthritis recruited from a cohort in the United Kingdom. Multipliers relating the wage to marginal productivity were also derived using the questionnaire. **Results:** The final questionnaire includes items on employment status; absenteeism; presenteeism; unpaid work; and job characteristics, which includes questions on team dynamics, availability of substitutes and their substitutability, time sensitivity, and compensation mechanisms. The importance of incorporating these questions demonstrated that when one employee was absent, or present at work but unable to work at full capacity, the consequent output loss could exceed the output of the employee alone. Multipliers were shown to be greater than one and represented the excess output loss. **Conclusions:** The new questionnaire enabled the job and workplace characteristics to be captured so that the actual productivity loss at the societal level attributable to absenteeism and presenteeism could be valued.

Keywords: absenteeism, job and workplace characteristics, presenteeism, productivity, wage multiplier.

Introduction

The influence of various health problems on productivity loss has been well documented during recent years [1–9]. Productivity losses have also been the attention of both cost-of-illness studies and economic evaluations of health programs where they have been found to substantially affect findings. For example, productivity costs were found to contribute 23% of the burden of heart disease in the United Kingdom [5]. In economic evaluations, the inclusion of productivity costs in treatments for early rheumatoid arthritis (RA) changed the more expensive strategy from being not cost-effective to cost-saving [10]. There are, however, variations in the way productivity costs are measured and valued. The most basic method to estimate productivity loss from a societal perspective is to first measure the amount of time lost; for example, the number of lost days or hours of work, and then to value this loss according to the wage rate. Although this method has largely been adopted due to ease of administration and estimation, it has some important limitations because the wage may not represent the value of lost productivity at the level of the workplace or society. This article first summarizes the theory behind measuring and valuing productivity losses from a societal perspective, and provides a rationale for a new instrument that was consequently developed. Next, the development and preliminary testing of this instrument is described to examine its usefulness and feasibility.

Methods

Rationale

According to economic theory, the concept of productivity loss due to illness is based on the concept of a production function, where output is a function of capital input, labour input, and technology [11,12]. Thus, productivity loss due to illness is actually the output loss corresponding to the reduced labour input due to illness [1]. The focus of most existing productivity measurement questionnaires has been on the individual's labour input—measuring the time a person is not at work due to health (absenteeism) or is not productive while at work due to health (presenteeism). Productivity loss is then valued in monetary terms by multiplying

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the time loss so obtained by the relevant wage rate. Wage rate is commonly used to value work time loss because it is supposed to be equal to marginal productivity based on economic theory.

Wage, however, is not equal to the marginal productivity or does not reflect the actual value of productivity loss for the workplace or society for certain reasons. These include allowances for sick days and risk aversion of workers, as well as job and workplace characteristics such as team production, availability of perfect substitutes, and time sensitivity of output [1,13]. According to Pauly et al. [13], when an employee is absent from work, the actual productivity loss will exceed his/her wage if a substitute cannot be found or the substitute is less productive or costs more and if team work is involved, and/or penalties occur for failure to achieve the targeted output levels according to expected time schedules. Therefore, wage is diverged from marginal productivity because of these job and workplace characteristics.

Due to the discrepancy between wage and marginal productivity, multipliers relating wage rates to marginal productivity need to be derived first to value productivity loss. Productivity loss can then estimated by multiplying time loss and wage rate with a multiplier corresponding to the study subject's job and workplace characteristics. To develop multipliers and thus to value productivity loss, in addition to time loss, it is necessary to measure job and workplace characteristics such as job and industry type, interaction within a team, availability of substitutes, and their substitutability. It would require detailed information from both employees and their employers. However, using standard experimental designs common in health research, such as, clinical trials, it would be impractical (both ethically and logistically) to recruit both patients and their employers/managers to participate in a study to assess the influence of an illness or the effect of a therapeutic intervention on productivity. Typically, we can only collect the information from study participants who are employees.

The only studies to date that have attempted to estimate multipliers for productivity loss are those by Pauly et al. [14,15]. In these, managers instead of employees were interviewed to obtain estimates of the influence of absenteeism and presenteeism on output for different job and workplace characteristics, including team production, availability of perfect substitutes, and time sensitivity. The multipliers were defined as the cost of absenteeism and presenteesim to the firm as a proportion of the worker's wage, which is often greater than one. The authors argued that managers were best able to assess the influence of a worker's health problems on productivity because the managers considered work output whereas the worker's focus was limited to work input [14,15]. The influence on productivity assessed by managers, however, might not reflect the effect on the actual productivity at the workplaces. In addition, using the multipliers by Pauly et al. [14,15] in a study requires a match between each study participant's job type and the job types studied by Pauly et al. [14,15] and an assumption that their study samples are representative and thus the multipliers were generalizable. With the limited number of job and firm types studied by Pauly et al. [14,15], only certain jobs were covered. Furthermore, given the data was from the United States only, the multipliers may not be applicable to other countries that have different economic systems; for example, labor market, market power of firms, and firm types. Therefore, an alternative source for deriving multipliers is required.

Many questionnaires have been developed to directly measure time loss in days or hours, or to indirectly translate the influence of health problems into percentage of time loss [16] such as the Health and Labour Questionnaire (HLQ) [17], the Work Productivity and Activity Impairment Questionnaire (WPAI) [18] and the PRODuctivity and DISease Questionnaire (PRODISQ) [19]. Although the PRODISQ includes questions on workplace characteristics to adjust for possible compensation in case of absence from work due to disease, no one questionnaire captures time input loss as well as information on job and workplace characteristics, necessary for valuing output loss resulting from the time input loss. A questionnaire can be developed to address this need.

Another issue is that people make a trade-off between paid work, unpaid work, and leisure. It has been suggested that a questionnaire attempting to completely measure labor input loss should take considerations of the time spent on these three types of activities, the corresponding time loss as well as their trade-off [1]. Therefore, in addition to time loss from paid work, a questionnaire also needs to capture time loss from unpaid work.

It is worth noticing that we are developing a questionnaire valuing productivity loss from a societal perspective instead of a workplace perspective. There are both overlaps and distinctions between workplace perspective and societal perspective [1]. Absenteeism and presenteeism are valued similarly from the viewpoints of workplace and society. When an employee quits a job due to their health, however, the loss for the workplaces only occurs until they find a perfect substitute and for society the loss is the potential value of the human capital for the employee. Furthermore, unpaid work loss does not matter to workplace but does matter to the society.

Questionnaire development

Content development

Several comprehensive systematic reviews of questionnaires measuring productivity loss have previously been published [20–24]. Because our questionnaire focused on valuation instead of measurement of time loss, we did not create new questions measuring time loss if the measurement of time loss (question) was already available and captured employment status changes, such as job loss; early retirement; or reduced routine work hours, absenteeism, presenteeism, and unpaid work activities.

As a starting point, an expert group consisting of rheumatologists, health economists, and psychometricians reviewed the content of the published questionnaires. The preliminary objective was to consider developing a questionnaire for use in patients with RA, a disease that has well documented effect on productivity [3,9,25,26]. A battery of items was first sourced by selecting the questionnaires with frequent application and strong evidence of validity in arthritis and/or musculoskeletal disorders. The questionnaire battery included the RA Work Instability Scale (RA-WIS) [27], Workplace Activity Limitations Scale (WALS) [28], Work Limitations Questionnaire (WLQ) [29], Quantity and Quality instrument (QQ) [19,30,31], WPAI [18], HLQ [17], and PRODISQ [19]. We grouped the items from different questionnaires according to the following components we thought important to measure: employment/unemployment status, absenteeism, presenteeism, unpaid work activity loss, as well as job and workplace characteristics (Table 1). After consideration, the questions contained within the WLQ, QQ, WPAI, HLQ, and PRODISQ were considered to be most suitable for estimation of productivity loss because the RA-WIS and WALS concentrated more on "difficulties" experienced by ill workers but not on "productivity."

Item reduction

To reduce the items for each of the five components, we organized items by content, identified similar items, and eliminated duplication. When choosing between items sharing similar content, we considered primarily the wording of the question and the format of the response options from the perspective of their suitability for cost estimation. That is, as shown in Table 1, only those items that have potential or are currently used for cost estimation were considered. Furthermore, we followed the guidelines on how to measure productivity that was summarized in the previous publica-

Table 1 – Questionnaire battery for measuring productivity loss.

Instrument	Concept	Scale	Employment/ unemployment status	Absenteeism	Presenteeism	Unpaid work activity loss	Job and workplace characteristics			
							Team production	Availability of perfect substitutes	Compensation mechanisms	Time sensitivity
RA WIS	The extent of any mismatch between functional incapacity and work demands and its potential impact on job retention and security	Single scale of 23 items			Y					
WALS	Amount/level of difficulty in doing specific work related tasks	Single scale of 11 items			Y					
WLQ	Proportion of time having difficulty undertaking specific work related tasks	4 domains: • Physical • Mental-interpersonal • Time management • Output demands			Y ($)					
WPAI – GH	Degree of work and activity impairment	7 questions and 4 scores: • % health time missed • % impairment while working • % overall impairment • % activity impairment	P ($)	Y ($)	Y ($)	Y				
QQ	Quantity and quality of work	2 VAS questions: • Quantity of work done compared to normal • Quality of work done compared to normal			Y ($)					
HLQ	Time amount experiencing various aspects of reduced productivity at paid and unpaid work and impediments	4 modules: • Absence from work • Productivity at work • Unpaid work • Impediments to paid and unpaid labour	Y ($)	Y ($)	Y ($)	Y ($)				
PRODISQ	Illness and productivity of individuals and productivity costs at an organisational level	7 modules: • General • Occupation, income and workplace • Absenteeism • Compensating mechanisms in the event of absence • Productivity costs during work using QQ • Productivity costs at departmental level • Administrative and management costs of absence	P ($)	Y ($)	Y ($)		P*		P	Y*

HLQ, Health and Labour Questionnaire [17]; P, partially measured; PRODISQ, PROductivity and DISease Questionnaire [19]; QQ, Quantity and Quality method [19,30,31]; RA WIS, Rheumatoid Arthritis Work Instability Scale [27]; WALS, Work Activity Limitations Scale [28]; WLQ, Work Limitations Questionnaire [29]; WPAI-GH, Work Productivity and Activity Impairment - General Health [18]; Y, measured; $, potential or current utilization for cost estimation.

* Questions intended for employers/managers to answer; if not indicated, questions for study participant to answer.

tion [1]. For example, to estimate the costs, it has been recommended to measure the loss in terms of time amount first and then multiply it by the value of the time [1]. In addition, job and workplace characteristics such as job and industry type, interaction within a team, availability of perfect substitute, and compensation mechanism have influences on the value of productivity loss and thus need to be measured for valuation purpose [1]. A draft questionnaire was thus developed, named the Valuation Of Lost Productivity (VOLP) [32] based on those remaining items after reduction, adaptations and improvements of existing questions according to the expert group's recommendations. The VOLP is a generic questionnaire assessing the labour input loss due to health (any physical, mental, or emotional problems or symptoms). The questionnaire consists of six sections: employment status, job characteristics, absenteeism, work performance, unpaid work, and working environment (e.g., teamwork, substitutability).

The section on employment status distinguishes between working full time for pay, working part time for pay and self-employment and identifies the unemployment status (e.g., retired, homemaker), unemployment due to health and the employability for unemployed individuals. Unemployment due to health implies complete loss of labor input for individuals in paid employment.

Absenteeism is measured by the number of absent workdays due to health in the past 3 months, a question adapted from the PRODISQ [19]. A 3-month recall period was proposed by Severens et al. [33] and Revicki et al. [34].

Presenteeism, reduced work performance at work, is measured by an hour estimating method as per the HLQ [17]. Respondents are first asked to think of the work they completed during the past 7 days and answer if they would complete the same work in less time if they did not experience any health problems. If yes, they are asked to indicate the time in hours they actually used to do all the work during the past 7 days, and the time they would use to do the same work if they did not experience any health problems. In this way, by controlling for work quality (the same work), the work quantity when an individual has health problems is compared with that when he or she was healthy. Meanwhile, a 0 to 10 scale measuring presenteeism from the WPAI was also included in the draft for comparison and empirical testing. A 7-day recall period is used because it has been validated and supported in previous studies [1,35].

The influence of health on unpaid work is measured by asking how much time is spent on such activities as household work, shopping, odd jobs and chores, childcare, and volunteer activities and how much time respondents get paid and/or unpaid help with their unpaid work. These questions were adapted from the HLQ [17] and a 7-day recall period was applied.

More importantly, for valuation purpose, the VOLP collects information on job characteristics and working environment in addition to the labor time input loss in terms of absenteeism, presenteeism, and unpaid work loss. Job characteristics include job title, industry type, work habit, weekly work hours and days, and income. In addition, based on initial interview questions used by Pauly et al. [15] and questions from PRODISQ [19], the VOLP asks about team dynamics (size of working team, effect of the respondent on the team's function), substitutability (if colleagues or temporary workers can complete the same work using the same time amount), time sensitivity (if work can be postponed easily without any consequences), compensation (if work is taken over by others or postponed when the respondent is absent or present at work but less productive) and availability of substitutes (who—colleagues, managers, temporary workers or no one—takes over the work when the respondent is absent or present at work but less productive).

Pretesting and revisions

A focus group was recruited to test the draft VOLP's feasibility by seeking patients' views on the various types of questions and response formats associated with the content and the clarity of the draft VOLP. In the draft VOLP, two alternative formats for questions on absenteeism and unpaid work were included. The study testing the VOLP questionnaire in the focus group was approved by the Behavioural Research Ethics Board of the University of British Columbia.

A total of 15 employed people with RA were recruited for the focus group meeting. Their occupations mainly fell into the job categories of clerks, professionals, managers, or technicians. The meeting lasted approximately 3 hours. After an introduction by the principal investigator, the participants were asked to complete the draft VOLP. Then the participants were randomly divided into two groups. In each group, one facilitator then led an audio taped discussion regarding their preference between various types of questions, if the questions were easily understood, and if the questions accurately captured their loss in paid work and unpaid work. The draft VOLP was modified according to the feedback from the participants. The main changes include that 1) we confirmed that the questions asking for the loss due to general health are preferred to those asking for the loss due to the specific disease, RA; 2) for the question asking for the employability of unemployed individuals, we split the option "Yes" into two options: "Yes, I am able to work full time" and "Yes, I am only able to work part time"; 3) we asked for the compensation (if work is taken over by others or postponed when the respondent is absent) for the most recent period of absence instead of that for the longest and the shortest period of absence; and 4) suggested by the focus group, we added one more motivating and positive question, "did you work harder than your coworkers because of your health" before asking presenteeism. Because the changes were minimal, we did not undertake additional testing of the modifications made to the questions.

Preliminary assessment study

The modified VOLP was then tested in patients with early RA who were enrolled in the Early Rheumatoid Arthritis Network (ERAN) cohort based in the United Kingdom and who reported to be in paid work at their recent follow-up. Each participant was mailed and completed the VOLP at home. Some simple debriefing questions included within the assessment were also asked to ascertain any issues or difficulties with the VOLP. Ethical approval was gained from West Herts Multi-centre Research Ethics Committee in the United Kingdom.

Results

Subsequent to study initiation, a total of 354 patients who were employed during their most recent follow-up in ERAN were contacted for the study and 186 (53%) agreed to take part in the study and were sent the VOLP draft questionnaire. One hundred fifty-two completed the questionnaire, of which 140 were working for pay (67 full time and 54 part time) or self-employed (n = 18) and were included in our analysis (Table 2). The average age of the employed patients was 52 years old and 74% were female. Their disease duration was 48 months since the onset of symptom and 37 months since first rheumatology visit. Thirty-one (22%) employed patients were working with light or heavy loads. Debriefing responses at the end of the questionnaire found few problems. Less than 10% (n = 13) of respondents found the questionnaire to be too long, whereas only 15% (n = 21) had some difficulties with the questions. Most comments were general (e.g., questions are repetitive, not related to/fitting their work) although five people specifically identified difficulties with multiplier related questions in the VOLP, yet did not offer alternatives.

Table 2 – Demographic and job characteristics.

Variables (N = 140)	Mean (SD)	Median (Q1-Q3)
Age	51.6 (10.0)	52.1 (45.0-59.3)
Duration since onset of symptom (mo)	48.5 (23.6)	46.0 (33.0-59.0)
Duration since first clinic visit (mo)	37.2 (18.4)	35.5 (23.5-50.2)
No of work d/wk	4.6 (1.1)	5.0 (4.0-5.0)
No of work h/wk	32.6 (12.7)	35.0 (22.5-40.0)
	N	%
Female	104	74.3
Work status		
Full time	67	47.9
Part time	54	38.6
Self-employed	18	12.9
Work habits		
Usually sit	51	36.4
Stand or walk	53	37.9
Light load	20	14.3
Heavy load	11	7.9
Job category		
Manager	20	14.3
Professionals	22	15.7
Technicians	16	11.4
Clerk	24	17.1
Services and sales	37	26.4
Agriculture and fishery	4	2.9
Craft	7	5.0
Operators	7	5.0
Elementary occupations	3	2.1
Income (£)		
Prefer not to answer	13	9.3
<10,000	30	21.4
10,000–19,999	53	37.9
20,000–29,999	24	17.1
30,000–39,999	12	8.6
≥40,000	7	5.0

Note: If the percentages do not add up to 100%, the remaining is the missing rate.
SD, standard deviation; Q1: first quartile; Q3: third quartile.

Compensation and availability of substitutes for absenteeism and presenteeism

Only 60 patients who were absent from work due to health in the past 3 months were asked about compensation and availability of substitutes for their most recent absence. Of them, 42% reported their work was taken over by others, 22% reported their work was postponed, and 28% reported their work was partially taken over and partially postponed. About 75% reported that coworkers, supervisors, or temporary workers mainly took over their work when they were absent (Table 3). All employed patients were asked about compensation and availability of substitutes for presenteeism. About 29% patients reported their work was taken over, 24% postponed, and 37% partially taken over and partially postponed. A total of 97 (69%) employed patients reported coworkers, supervisors, or temporary workers would take over their work if they were at work but unable to work.

Teamwork, substitutability, and time sensitivity

Among all employed patients, 22 (16%) patients did not work in teams whereas 24 (17%) patients worked in teams all the time (Table 3). Among those 113 patients who worked in a team at least

Table 3 – Workplace characteristics.

Variables	N	%
Compensation and availability of substitutes for the most recent absent period (n = 60)		
Work taken over?		
Do not know	2	3.3
Taken over by others	25	41.7
Partly taken over partly postponed	17	28.3
Postponed	13	21.7
Who took over work?		
Coworkers or supervisors	42	70.0
Temp workers	3	5.0
No one	12	20.0
Compensation and availability of substitutes for presenteeism (n = 140)		
Work taken over?		
Do not know	7	5.0
Taken over by others	41	29.3
Partly taken over partly postponed	52	37.1
Postponed	34	24.3
Who took over work?		
Do not know	9	6.4
Coworkers or supervisors	90	64.3
Temp workers	7	5.0
No one	28	20.0
Teamwork (n = 140)		
Work with team?		
None of the time	22	15.7
A little of the time	25	17.9
Some of the time	33	23.6
Most of the time	31	22.1
All the time	24	17.1
No of coworkers in the team (n = 111), mean (SD)	4.4 (4.1)	
Impact on team function (n = 113)		
Function as usual	27	23.9
Affected a little bit	28	24.8
Affected somewhat	25	22.1
Affected quite a lot	26	23.0
Can not function	5	4.4
Substitutability (n = 140)		
Coworkers doing same work?		
Yes	103	73.6
No	32	22.9
Can coworkers do your work?		
Same	57	40.7
Need a little bit more time	16	11.4
Need somewhat more time	23	16.4
Need a lot more time	11	7.9
Can not do my work	25	17.9
Temp workers hired?		
Yes	32	22.9
No	99	70.7
Can temps do your work? (n = 32)		
Same	9	28.1
Need a little bit more time	6	18.8
Need somewhat more time	10	31.3
Need a lot more time	3	9.4
Can not do my work	4	12.5
Time sensitivity (n = 140)		
0 Work can be postponed easily without consequences	8	5.7
1	16	11.4
2	16	11.4
3	30	21.4
4	32	22.9
5 Can not be postponed without severe consequences	33	23.6

Note: If the percentages do not add up to 100%, the remaining is the missing rate.
SD, standard deviation.

Teamwork

- Frequency of working with team (X): none of the time = 0%, 2 = 25%, 3 = 50%, 4 = 75%, all the time = 100%
- Number of team members potentially affected (Y)
- Impact on team function (Z): function as usual = 0%, 2 = 25%, 3 = 50%, 4 = 75%, can not function 5 = 100% (indicating % of the team's work that was affected)

Substitutability

- Can coworkers do your work? (C): same = 0%, 2 = 25%, 3 = 50%, 4 = 75%, can not do my work = 100% (indicating in a certain time period, % of work can not be completed by coworkers)
- Can temps do your work? (T): same = 0%, 2 = 25%, 3 = 50%, 4 = 75%, can not do my work=100% (indicating in a certain time period, % of work can not be completed by temps)

Multipliers depending on availability of substitutes
Who took over work?

1) Coworkers or supervisors: Multiplier = $(1 + C \times X \times Y \times Z)$
2) Temp workers hired from external agency: Multiplier = $(1 + T \times X \times Y \times Z)$
3) No-one: Multiplier=$(1 + X \times Y \times Z)$

For example,

- *If an employee does not work with team (X = 0), or his absence/presenteeism does not affect team function (Y = 0), or his coworker/supervisor/temp as a substitute does his work perfectly (C = 0), then Multiplier = 1;*
- *If an employee spends 25% of work time (X = 25%) working with 4 other team members (Y = 4) and his absence/presenteeism has 25% impact on team work (Z = 25%);*
  - *If the coworker/supervisor/temp as a substitute can not complete 25% of the work within a certain time period (keeping team idle) (C = 25% or T = 25%), then Multiplier = (1 + 25% × 25% × 4 × 25%) = 1.06;*
  - *If no one substitutes for him, then Multiplier =(1 + 25% × 4 × 25%) = 1.25.*

Multipliers when considering compensation mechanisms

- If lost work is not compensated or can not be compensated without cost (the cost is assumed to be equal to the wage), then productivity loss will be lost work time multiplied by wage and the multipliers depending on the availability of substitutes; that is, the multipliers above;
- If lost work can be fully or partially compensated without cost, then productivity loss will be zero or uncompensated lost work time multiplied by wage and the multiplier for scenario when no one takes over work; that is, $(1 + X \times Y \times Z)$.

Fig. 1 – Calculating multipliers from the Valuation of Lost Productivity questionnaire.

a little of the time, 24% reported their team could function as usual when they were absent from work or when they were at work but unable to work and 4.4% reported their team could not function at all. One hundred and three (74%) patients reported that they had coworkers doing the same work as theirs but only 57 patients (41%) thought that their coworkers could complete their work using the same amount of time as they use. Thirty-two (23%) patients reported their workplaces hired temporary workers from agencies to do the same work but 28% of these 32 patients thought that the temporary workers could complete their work using the same amount of time as themselves. When asked if their work could be postponed easily without consequences, 8 (6%) answered their work could be postponed easily and 33 (24%) answered their work could not be postponed without severe consequences.

Multipliers accounting for teamwork and substitutability

As mentioned above, Pauly et al. [15] generated wage multipliers for absenteeism and presenteeism by more than 20 specific job types. Using the VOLP itself, we also attempted to derive multipliers by assuming they are at least equal to one. We applied an additive algorithm to calculate multipliers for each employed patient according to their workplace characteristics (Fig. 1). We imputed the amount 0%, 25%, 50%, 75%, and 100% to the five Likert options for frequency of working with team and influence on team function to indicate percent of the team's work that was affected. Similarly, we imputed the amount to the five Likert options for substitutes' ability to do the work to indicate in a certain time period, percent of work could not be completed by coworkers or temporary workers. We assumed the output from a team was the sum of each member's wage and the wage for each team member was the same. Thus, if one employee was absent and no substitute was available, the loss was the employee's wage plus the other team members' wages. If a substitute was available, the loss was the employee's wage and part of the other team members' wage depending on the ability of the substitute to do the work. We did not take into account time sensitivity of output when calculating multipliers from the VOLP because the associated loss can be arbitrary and was hard for employees to estimate. To get the corresponding multiplier by Pauly et al. [15], we matched the job title of each study patient to the job type list identified by Pauly et al. [15]. The wage multipliers according to Pauly et al. [15] and the VOLP were presented in Table 4 by nine broader job categories. Please note that there were 67 patients who were working with similar job titles to those identified by Pauly et al. [15]. However, due to the missing data and the fact that the VOLP absenteeism multipliers could be derived only for patients who reported absence, multipliers according to Pauly et al. [15] and the VOLP were both available among 27 patients only for absenteeism and 58 patients for presenteeism. The first row in Table 4 for each job category reported multipliers for the job titles available in both the VOLP and Pauly et al. [15]. The second row reported multipliers for the job titles only available in the VOLP and the third row for those available in Pauly et al. [15] only. For absenteeism, there were more than five patients having multipliers using both methods in clerk job category and services and sales category. The multipliers developed from the VOLP were slightly higher. For presenteeism, in the job categories with more than five patients having multipliers using both methods, the multipliers from the VOLP were smaller than those from Pauly et al. [15].

Table 4 – Multipliers for absenteeism and presenteeism.

Job category	Absenteeism			Presenteeism		
	n	VOLP	Pauly et al.	n	VOLP	Pauly et al.
Manager	1	2.41	1.89	5	1.63	2.36
	5	4.68	–	15	2.78	–
	4	–	1.82	0	–	–
Professionals	3	1.64	1.52	8	1.40	2.29
	7	1.97	–	12	1.32	–
	5	–	1.70	0	–	–
Technicians	2	1.00	1.36	4	1.09	2.41
	7	1.78	–	10	1.55	–
	3	–	1.71	1	–	1.59
Clerk	6	1.54	1.52	15	1.35	2.03
	6	1.27	–	7	1.25	–
	10	–	1.52	1	–	2.43
Services and sales	11	1.81	1.33	20	1.31	1.84
	5	1.07	–	12	1.08	–
	11	–	1.43	2	–	1.59
Agriculture and fishery	0	–	–	1	1.00	2.66
	2	1.00	–	3	1.03	–
	1	–	1.35	0	–	–
Craft	2	2.69	1.70	1	4.38	3.50
	1	1.63	–	2	1.31	–
	3	–	1.70	4	–	2.63
Operators	1	1.19	1.89	3	1.06	2.03
	2	1.00	–	2	2.13	–
	2	–	1.28	0	–	–
Elementary occupations	1	1.19	1.05	1	1.38	1.47
	1	1.00	–	1	1.00	–
	1	–	1.05	1	–	1.47

Note: For each job category, the first row reported multipliers for the job titles available in both the VOLP and Pauly et al. [15]; the second row reported multipliers for the job titles only available in the VOLP and the third row for those available in Pauly et al. [15] only.
VOLP, Valuation Of Lost Productivity questionnaire; "–", not available.

Discussion

The VOLP questionnaire was developed for valuation of productivity loss from a societal perspective according to accepted principles in the economic evaluation literature. We developed the VOLP for users who want to measure health-related time loss for the individual as well as the multipliers for valuing the societal loss using one complete questionnaire. Since the VOLP is a composite questionnaire, questions might also be separated for use depending on the study purposes. For example, questions on absenteeism, presenteeism, and unpaid work activity loss could be used to measure the time lost because of health problems. The validity and reliability of the VOLP measuring time loss have been tested in a separate study [36]. Questions on job and workplace characteristics, including team dynamics, availability of substitutes, and substitutability can be used to generate multipliers for valuation purpose. These questions might be combined with other questionnaires that are also able to measure lost time such as WPAI [18], HLQ [17], and PRODISQ [19] (which were used in developing the questions in the VOLP). When questions are used separately or combined with another questionnaire, care should be taken to ensure the consistency of recall periods and question wordings between VOLP questions and other questionnaires. The validity of using the VOLP questions separately outside the context of the whole questionnaire may also need to be further examined.

In this study, using the VOLP questionnaire we measured the job and workplace characteristics of employed people with RA. Most employed patients' work would be taken over or partially taken over if they were absent from work (70%) or present at work but sick (66%) (Table 3). This indicated there are good compensation mechanisms in most workplaces. These questions, however, could not indicate whether the compensation was done during normal working hours or extra working hours. Therefore, lost work could not be corrected for compensation mechanisms as done by Jacob-Tacken et al. [37] and Severens et al. [38] who assumed that no loss would occur if missed work was compensated by the absent worker later during normal working hours and/or his/her colleagues during normal working hours.

The majority of employed workers work in a team at least a little of the time. When they are absent or when they are at work but unable to work at full capacity, this can affect the function of the entire team. Over half of the workplaces in our study did not have regular employees or temporary workers who were perfect substitutes of the study workers with absenteeism or presenteeism. On time production or time sensitivity of output; that is, the work cannot be postponed easily without consequences was also noted. These findings confirmed that when one employee is absent or present at work but unable to work at full capacity, the output loss at their workplace exceeded the output of the employee alone because the entire or partial output of the workers team may be lost.

It is worth noting that the concept of teamwork can be very broad. In the management literature, a variety of team design features have been found positively correlated with team performance [39]. Stewart [39] classified team design features into three broad categories: group composition (aggregated characteristics, heterogeneity, team size), task design (interdependency, autonomy), and organizational context (leadership, training). In the VOLP, we did not incorporate all these categories. Instead, we only measured three aspects related to team production: frequency of working with a team, team size, and influence on team function.

In this article we proposed a different method of deriving wage multipliers. We used the VOLP itself to generate multipliers based on an assumption that each team member is paid similarly to the study subject and thus their output was additive. The additive algorithm is presented in Figure 1. The advantage of the method is that no external data are required to value productivity loss. Furthermore, the VOLP can be used in clinical trials, where it is infeasible and unethical to ask both patients and their managers questions about productivity. In studies of Pauly et al. [13–15], the managers instead of the employees rated the teamwork, availability of perfect substitute, and time sensitivity factors. Managers were thought to be in a better position to consider and understand output than the employees. The VOLP did not ask employees to value the output directly but just to answer output-related workplace characteristics questions. The low number of missing responses (Table 3) suggests good awareness of employees about their workplace characteristics. It is still possible that the personality or cognitive characteristics of employees (e.g., self-enhancing biases) would influence the validity of the measures on team function and substitutability.

Multipliers based on employees' self-reported responses have potential limitations. They cannot capture time sensitivity because it is hard for employees themselves to estimate the magnitude of the corresponding impact. Also, the additive assumption of output is questionable. Furthermore, it is not recommended to generalize the study results (multipliers by job categories) to other study populations with different cultures. In practice, the VOLP should be used to obtain the multiplier for each study participant. One alternative to overcome these limitations as in Pauly et al.

[14,15]; that is, was to survey a large, representative sample of managers in different countries. But either managers or employees do not know the actual productivity. Another method is to use the existing population-based datasets linking employees' input to their employers' output. Such databases can be used to test the null hypothesis that wage is equal to marginal productivity. If the hypothesis is rejected, the wage multipliers can then be developed for a wide variety of job types. An advantage of this method is that such population-based dataset provide actual productivity estimates. The Workplace and Employee Survey conducted by Statistics Canada [40] is such a database that we can use to generate wage multipliers for different jobs and workplace characteristics. Importantly, for both alternative methods described, it will be still necessary to collect detailed information about job type and workplace characteristics from study participants. Hence, the VOLP has the ability to value productivity loss using internal responses and/or using multipliers for different job and workplace characteristics developed from external data.

We propose that from a theoretical standpoint, using a societal perspective, marginal productivity is more likely to be equal or higher than wage and so multipliers relating wage to marginal productivity should be equal or greater than one. Our multipliers have taken into account the additional effects of absenteeism and presenteeism on the work team. The magnitude of the impact depends on the availability of substitutes and their substitutability (Fig. 1). There are strong theoretical grounds for the multiplier being greater than one when taking into account the effects of teamwork [13]. Of course, it will be important to validate this theoretical model with empirical evidence of actual/objective measures of productivity. We plan to use Workplace and Employee Survey data to examine this in the future.

Importantly, compensation mechanisms could also have an influence on productivity loss. In the literature, different assumptions have been made in terms of the effect. It has been suggested that compensation mechanisms in workplaces could reduce quantity of lost work and thus productivity loss [37,38]. Others have argued that compensation mechanisms themselves are not costless [1,41]. For example, the absent worker or colleagues who take over the work might have to sacrifice their leisure time or take more effort to make up the lost work even during normal working time. Based on economic theory, the value of lost leisure time and effort has been assumed to be equal to wage [41]. We did not incorporate such effect of compensation mechanisms into our multipliers. When considering compensation mechanisms, however, our multipliers are still relevant. For example, if lost work is not compensated or cannot be compensated without cost and the cost is assumed to be equal to wage, then productivity loss will be lost work time multiplied by wage and the multipliers depending on the availability of substitutes. If lost work can be fully or partially compensated without cost, then productivity loss will be zero or uncompensated lost work time multiplied by wage and the multiplier developed for the scenario when no one takes over the work (Fig. 1).

If a worker is absent from work or is at work but sick, we conclude that from the societal perspective, the output loss of the workplace may be more than the wage of the employee alone depending on workplace characteristics. We develop a measure to capture the essential information to measure the actual output loss attributable to absenteeism and presenteeism. Although our study demonstrates the feasibility of the VOLP, differences between multipliers from the VOLP, existing studies (e.g., Pauly et al. [14,15]) and other sources of data (e.g., Workplace and Employee Survey), should be investigated. The VOLP provides a new practical approach to value productivity loss associated with health from a societal perspective.

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REFERENCES

[1] Zhang W, Bansback N, Anis AH. Measuring and valuing productivity loss due to poor health: a critical review. Soc Sci Med 2011;72:185–92.
[2] Health Canada. Economic burden of illness in Canada, 1998. Ottawa: Minister of Public Works and Government Services Canada, 2002.
[3] Li X, Gignac MA, Anis AH. The indirect costs of arthritis resulting from unemployment, reduced performance, and occupational changes while at work. Med Care 2006;44:304–10.
[4] Anis AH, Zhang W, Bansback N, et al. Obesity and overweight in Canada: an updated cost-of-illness study. Obes Rev 2010;11:31–40.
[5] Luengo-Fernandez R, Leal J, Gray A, et al. Cost of cardiovascular diseases in the United Kingdom. Heart 2006;92:1384–9.
[6] Lamb CE, Ratner PH, Johnson CE, et al. Economic impact of workplace productivity losses due to allergic rhinitis compared with select medical conditions in the United States from an employer perspective. Curr Med Res Opin 2006;22:1203–10.
[7] Broekx S, Hond ED, Torfs R, et al. The costs of breast cancer prior to and following diagnosis. Eur J Health Econ 2011;12:311–7.
[8] Dodel I, Reese JP, Muller N, et al. Cost of illness in patients with Gilles de la Tourette's syndrome. J Neurol 2010;257:1055–61.
[9] Zhang W, Koehoorn M, Anis AH. Work productivity among employed Canadians with arthritis. J Occup Environ Med 2010;52:872–7.
[10] van den Hout WB, Goekoop-Ruiterman YP, Allaart CF, et al. Cost-utility analysis of treatment strategies in patients with recent-onset rheumatoid arthritis. Arthritis Rheum 2009;61:291–9.
[11] Mas-Colell A, Whinston MD, Green JR. Microeconomic Theory. New York: Oxford University Press, 1995.
[12] Hall RE, Lieberman M. Microeconomics: Principles and Applications. 4th ed. Mason, OH: Thomson South-Western, 2008.
[13] Pauly MV, Nicholson S, Xu J, et al. A general model of the impact of absenteeism on employers and employees. Health Econ 2002;11:221–31.
[14] Nicholson S, Pauly MV, Polsky D, et al. Measuring the effects of work loss on productivity with team production. Health Econ 2006;15:111–23.
[15] Pauly MV, Nicholson S, Polsky D, et al. Valuing reductions in on-the-job illness: 'presenteeism' from managerial and economic perspectives. Health Econ 2008;17:469–85.
[16] Beaton D, Bombardier C, Escorpizo R, et al. Measuring worker productivity: frameworks and measures. J Rheumatol 2009;36:2100–9.
[17] van Roijen L, Essink-Bot ML, Koopmanschap MA, et al. Labor and health status in economic evaluation of health care. The Health and Labor Questionnaire. Int J Technol Assess Health Care 1996;12:405–15.
[18] Reilly MC, Zbrozek AS, Dukes EM. The validity and reproducibility of a work productivity and activity impairment instrument. Pharmacoeconomics 1993;4:353–65.
[19] Koopmanschap MA. PRODISQ: a modular questionnaire on productivity and disease for economic evaluation studies. Expert Rev Pharmacoecon Outcomes Res 2005;5:23–8.
[20] Loeppke R, Hymel PA, Lofland JH, et al. Health-related workplace productivity measurement: general and migraine-specific recommendations from the ACOEM Expert Panel. J Occup Environ Med 2003;45:349–59.
[21] Prasad M, Wahlqvist P, Shikiar R, Shih YC. A review of self-report instruments measuring health-related work productivity: a patient-reported outcomes perspective. Pharmacoeconomics 2004;22:225–44.
[22] Lofland JH, Pizzi L, Frick KD. A review of health-related workplace productivity loss instruments. Pharmacoeconomics 2004;22:165–84.
[23] Mattke S, Balakrishnan A, Bergamo G, Newberry SJ. A review of methods to measure health-related productivity loss. Am J Manag Care 2007;13:211–7.

[24] Escorpizo R, Bombardier C, Boonen A, et al. Worker productivity outcome measures in arthritis. J Rheumatol 2007;34:1372–80.
[25] Lundkvist J, Kastang F, Kobelt G. The burden of rheumatoid arthritis and access to treatment: health burden and costs. Eur J Health Econ 2008;8:S49–60.
[26] Xie F. The need for standardization: a literature review of indirect costs of rheumatoid arthritis and osteoarthritis. Arthritis Rheum 2008; 59:1027–33.
[27] Gilworth G, Chamberlain MA, Harvey A, et al. Development of a work instability scale for rheumatoid arthritis. Arthritis Rheum 2003;49: 349–54.
[28] Gignac MA, Badley EM, Lacaille D, et al. Managing arthritis and employment: making arthritis-related work changes as a means of adaptation. Arthritis Rheum 2004;51:909–16.
[29] Lerner D, Amick BC 3rd, Rogers WH, et al. The Work Limitations Questionnaire. Med Care 2001;39:72–85.
[30] Brouwer WB, Koopmanschap MA, Rutten FF. Productivity losses without absence: measurement validation and empirical evidence. Health Policy 1999;48:13–27.
[31] Meerding WJ, IJzelenberg W, Koopmanschap MA, et al. Health problems lead to considerable productivity loss at work among workers with high physical load jobs. J Clin Epidemiol 2005;58:517–23.
[32] Valuation of lost productivity questionnaire. Available from: www.thevolp.com. [Accessed March 23, 2011].
[33] Severens JL, Mulder J, Laheij L, Verbeek V. Precision and accuracy in measuring absence from work as a basis for calculating productivity costs in The Netherlands. Soc Sci Med 2000;51:243–9.
[34] Revicki DA, Irwin D, Reblando J, Simon GE. The accuracy of self-reported disability days. Med Care 1994;32:401–4.
[35] Reilly MC, Bracco A, Ricci J, et al. The validity and accuracy of the Work Productivity and Activity Impairment questionnaire—Irritable bowel syndrome version (WPAI:IBS). Aliment Pharmacol Ther 2004;20: 459–67.
[36] Zhang W, Bansback N, Kopec J, Anis A. Measuring time input loss among patients with rheumatoid arthritis: validity and reliability of the Valuation of Lost Productivity questionnaire. J Occup Environ Med 2011;53:530–6.
[37] Jacob-Tacken KH, Koopmanschap MA, Meerding WJ, Severens JL. Correcting for compensating mechanisms related to productivity costs in economic evaluations of health care programmes. Health Econ 2005;14:435–43.
[38] Severens JL, Laheij RJ, Jansen JB, et al. Estimating the cost of lost productivity in dyspepsia. Aliment Pharmacol Ther 1998;12: 919–23.
[39] Stewart GL. A meta-analytic review of the relationships between team design features and team performance. J Manage 2006;32:29–54.
[40] Statistics Canada. The workplace and employee survey. Available from: http://www.statcan.gc.ca/cgi-bin/imdb/p2SV.pl?Function=getSurvey&SDDS=2615&lang=en&db=imdb&adm=8&dis=2. [Accessed March 23, 2011].
[41] Brouwer WB, van Exel NJ, Koopmanschap MA, Rutten FF. Productivity costs before and after absence from work: as important as common? Health Policy 2002;61:173–87.